Forest Vegetation Profiling with
AIRSAR Polarimetric Radar Interferometry

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Radar interferometry enables the measurement of forest vegetation characteristics as a function of altitude above the ground surface [1,2]. Along with techniques such as lidar [3] and low-frequency radar [4], radar interferometry is a candidate for estimating biomass using profiles of vegetation density. Introducing zero-baseline polarimetry does not improve the accuracy of vegetation parameter determination [5], without assumptions about the characteristics of the target, for example, about ground roughness. However, if polarimetric interferometry is also introduced at one or more baselines, polarimetric information can improve vegetation profiles. Because the sensitivity of interferometric phase as a function of vegetation scattering altitude is proportional to the baseline length over (wave length x radar altitude), varying the altitude is equivalent to varying the baseline. A data set of multialtitude polarimetric interferometry supplies a diverse number of observations from which vegetation profile parameters can be estimated.

Polarimetric interferometric data were acquired with AIRSAR in June 1999 over Central Oregon at 3 altitudes, 8 km, 4 km, and 2 km at C-band. L-band interferometric data were also acquired at V polarization. Unlike multiple repeat-pass interferometry, the fixed-baseline measurement does not invoke the need to model temporal vegetation effects between passes. The end product of this analysis is quantitative parameter estimates and parameter estimate errors. The physical model used in the analysis consists of two layers of randomly oriented vegetation, and a direct and specularly-reflecting (primarily for L-band) ground surface. Using polarimetric interferometry and zero-baseline polarimetry obviate the need for assumptions about ground roughness. Parameters estimated include the thickness of each vegetation layer (upper and lower), the extinction coefficient of each layer, the brightness ratio of each layer (from which density ratios can be estimated), the ratio of the ground brightness to layer brightness, and the altitude of the underlying surface [5].

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Session: Remote Sensing with AIRSAR: Data and Applications, Organizer: David Imel